97-84062-4

Robinson, Doane

Dam sites on the Missouri River in South Dakota

[Pierre? S.D.]

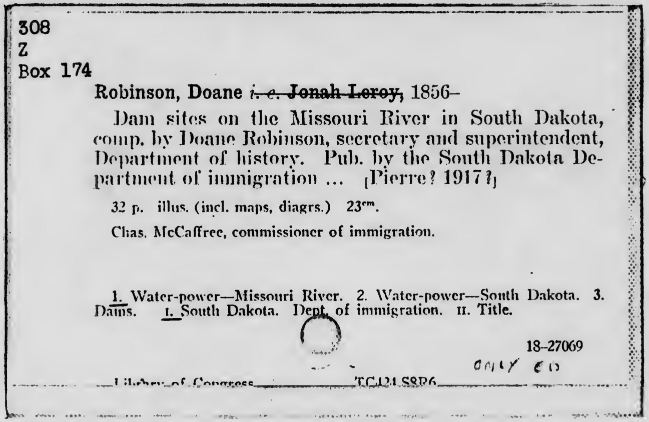
[1917?]

97-84062-4
MASTER NEGATIVE #

COLUMBIA UNIVERSITY LIBRARIES
PRESERVATION DIVISION

BIBLIOGRAPHIC MICROFORM TARGET

ORIGINAL MATERIAL AS FILMED - EXISTING BIBLIOGRAPHIC RECORD



308
Z
Box 174

Robinson, Doane ~~i. e. Jonah Leroy,~~ 1856–

Dam sites on the Missouri River in South Dakota, comp. by Doane Robinson, secretary and superintendent, Department of history. Pub. by the South Dakota Department of immigration ... [Pierre? 1917?]

32 p. illus. (incl. maps, diagrs.) 23^{cm}.

Chas. McCaffree, commissioner of immigration.

1. Water-power—Missouri River. 2. Water-power—South Dakota. 3. Dams. I. South Dakota. Dept. of immigration. II. Title.

18-27069

ONLY ED

Library of Congress TC424.S8R6

RESTRICTIONS ON USE: *Reproductions may not be made without permission from Columbia University Libraries.*

TECHNICAL MICROFORM DATA

FILM SIZE: 35mm **REDUCTION RATIO:** 10:1 **IMAGE PLACEMENT:** IA [✓ IIA] IB IIB

DATE FILMED: 4-2-97 **INITIALS:** B

TRACKING # : 23207

FILMED BY PRESERVATION RESOURCES, BETHLEHEM, PA.

INTENTIONAL
SECOND
EXPOSURES DUE TO
PHOTOGRAPHS AND
ILLUSTRATIONS

JAN 19 1918

308
Z
Box 174

DAM SITES

ON THE

MISSOURI RIVER

IN

SOUTH DAKOTA

Compiled by

Doane Robinson, Secretary and Superintendent
Department of History

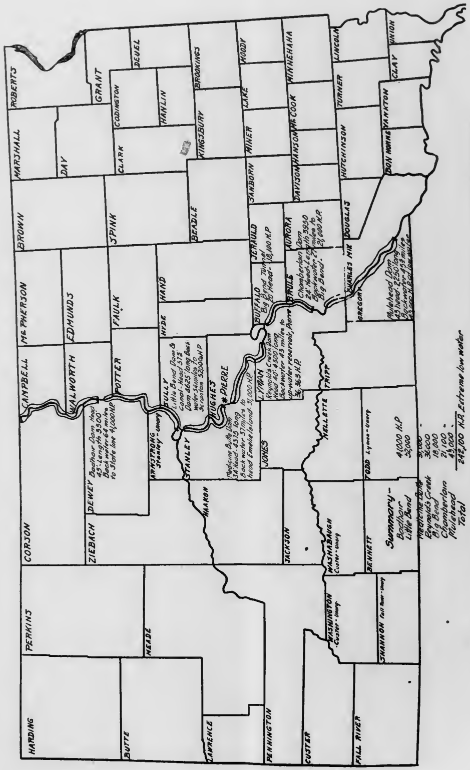
Published by

The South Dakota Department of Immigration

BOARD OF IMMIGRATION:

Peter Norbeck, Governor. Frank M. Rood, Secretary of
State, N. E. Knight, Commissioner of School
and Public Lands

Chas. McCaffree, Commissioner of Immigration


ROBERTS
MARSHALL
BROWN
McPHERSON
CAMPBELL
CORSON
PERKINS
HARDING
BUTTE
LAWRENCE
MEADE
PENNINGTON
CUSTER
FALL RIVER
SHANNON Fall River - Unorg
WASHINGTON Custer - Unorg
WASHABAUGH Custer - Unorg
BENNETT
TODD Lyman - Unorg
JACKSON
HAAKON
JONES
STANLEY
ARMSTRONG Stanley - Unorg
ZIEBACH
DEWEY
WALWORTH
EDMUNDS
DAY
GRANT
CODINGTON
DEUEL
HAMLIN
CLARK
SPINK
FAULK
POTTER
SULLY
HUGHES
PIERRE
HYDE
HAND
BEADLE
KINGSBURY
BROOKINGS
LAKE
MOODY
MINER
SANBORN
JERAULD
BUFFALO
BRULE
AURORA
DAVISON
HANSON
McCOOK
MINNEHAHA
LINCOLN
TURNER
HUTCHINSON
DOUGLAS
CHARLES MIX
GREGORY
LYMAN
MELLETTE
TRIPP
BON HOMME
YANKTON
CLAY
UNION
Bodhoir Dam Head 45'. Length 5500' Back water 64 miles to State line 41,000 H.P.
Little Bend Dam & Canal - Head 57.5' Dam 4625' long Back water 54 miles to Scranton 32,000 H.P
Medicine Butte Dam 34' Head - 4375 long Back water 37 miles to head Emelie Island. 31,000 H.P.
Reynolds Creek Dam Head 40'. 4500' long Backwater 43 miles to up-water reservoir, Pierre 36,363 H.P.
Big Bend Tunnel 70' Head - 18,100 H.P
Chamberlain Dam 24' Head - Length 3950 Backwater 27 miles to Big Bend. 21,000 H.P.
Mulehead Dam 43 head - 2250' long Backwater 45 1/2 miles 43,000 H.P. at low water
Summary -
Bodhoir 41,000 H.P
Little Bend 32,000
Medicine Butte 31,000
Reynold's Creek 36,000
Big Bend 18,000
Chamberlain 21,100
Mulehead 43,000
Total 242,100 H.P. Extreme low water

MAP OF SOUTH DAKOTA SHOWING SOME POTENTIAL POWER SITES

Rec'd Apr 8 1925

SOUTH DAKOTA'S GOOD FORTUNE

South Dakota is peculiarly fortunate in the natural formation of the Missouri river valley which makes it possible to construct a considerable number of Water powers upon that stream. This is a resource peculiar to South Dakota, where at frequent intervals the rim walls of the immediate valley of the stream approach each other so closely as to make the erection of dams feasible.

Examination of the section was made many years ago by General George W. Davis, the notable engineer of the Panama canal, who in the beginning of his military career was located at Fort Sully. He was perhaps the first to suggest the vast power potentalities of the middle Missouri reaches.

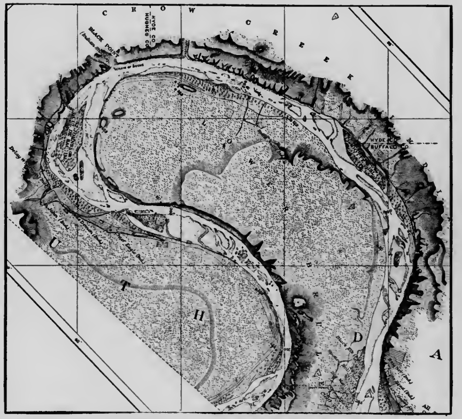
In 1911 the great engineering company, Westinghouse, Church, Kerr & Co., made a reconnoissance of the stream in central South Dakota and reported the physical conditions favorable to dam construction.

In 1917 Mr. W. H. Finley, chief engineer of the Chicago and Northwestern Railway confirmed this view with a favorable report upon physical conditions.

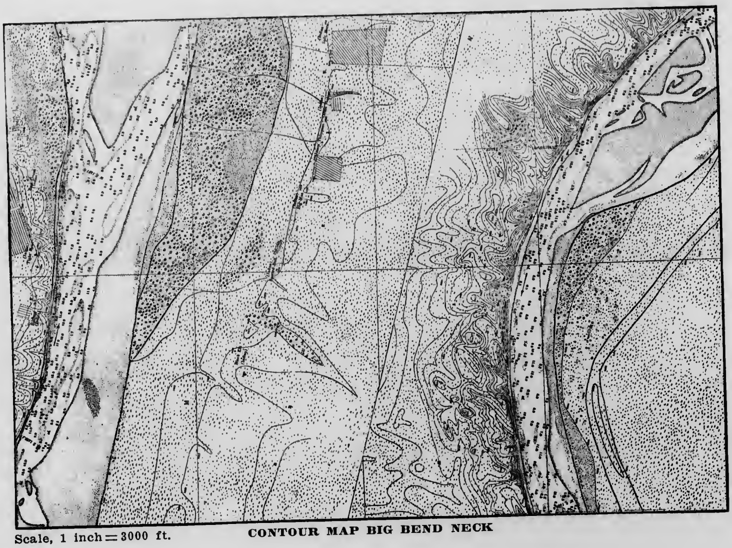
To successfully dam and hold the floods of the Missouri it will be necessary to build heavy works into bed rock entirely across the flood plain, from rim to rim. At the points indicated on the map and hereinafter described in detail the conditions are altogether favorable to such construction.

BIG BEND

The detour at Big Bend is from mile 286 to mile 310 being a distance of 24 miles. The distance across the neck is 1¾ miles and the height of the hill in the gorge is, according to Nelson's survey, 298 feet. The water level on the south side is 1421 feet and upon the north side 1441 feet making the net fall across the bend 20 feet, as shown by the contour map of the Chief of Engineers' U. S. Army, for 1889. As will be seen from an examination of the contour map published herewith there is a wide flat area on the north side of the river on the upper side of the neck of Big Bend. This flat has been produced by the slow progress of the river in cutting away the gorge, so that all of the area, fully five miles wide, now a magnificent, sub-irrigated meadow, is former river bed, across which it would be impracticable to build a dam. Consequently about the only practicable method of development for power purposes at Big Bend will be by tunnel of sufficient capacity to divert and carry the minimum flow of the stream. A tunnel 30x15 feet wide will do this at no extraordinary expense, producing about 18,000 horsepower. The tunnel proper will be about one mile in length, the remainder of the distance may be negotiated by open canal. To this extent Big Bend can be developed much more cheaply than any other tentative power site upon the river. It has been asked if the process of erosion above referred to will not continue and ultimately the neck be cut away. It is not impossible that this may occur but only after many hundreds, perhaps many thousands of years. Lewis and Clark measured the neck 113 years ago and found it practically what it is today.

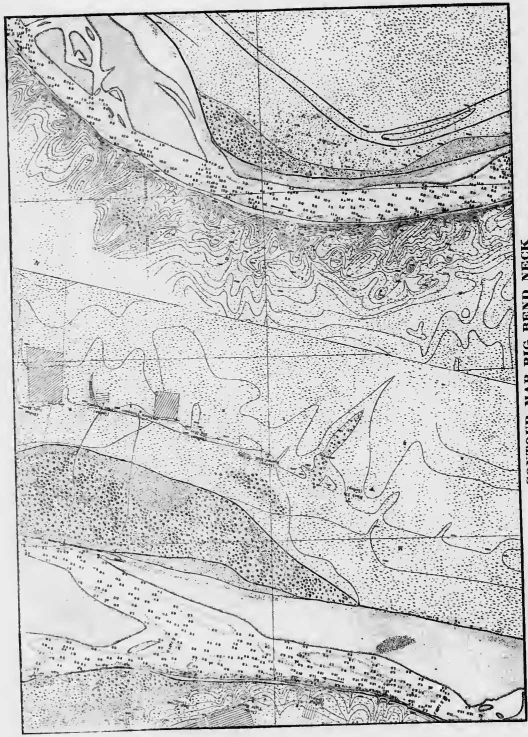


Scale, 1 inch = 3 miles
THE BIG BEND OF THE MISSOURI



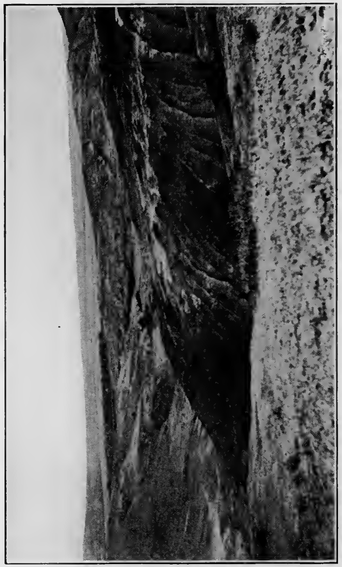
Scale, 1 inch = 3000 ft. **CONTOUR MAP BIG BEND NECK**

THE PASS AT LITTLE BEND NECK, WHERE A 57-FOOT HEAD IS PRACTICABLE

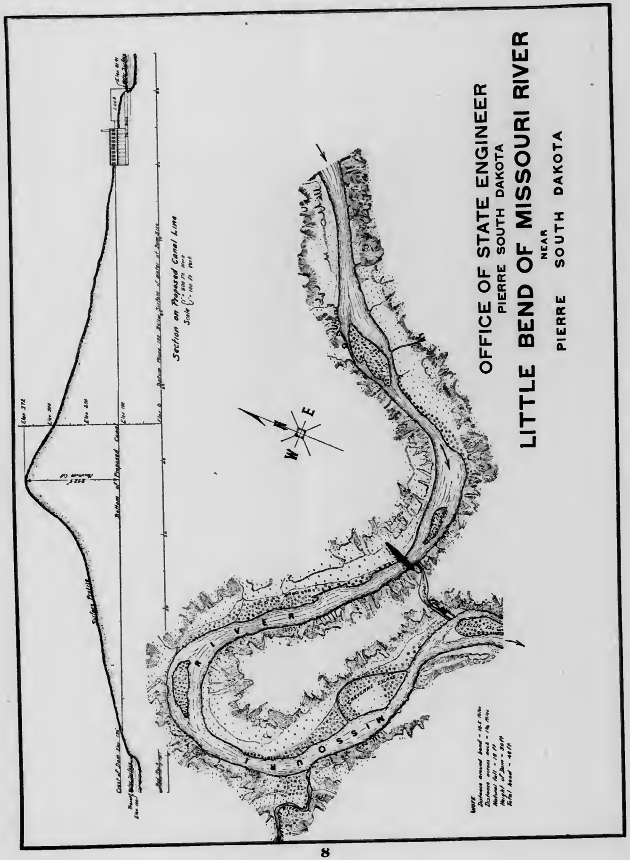


CONTOUR MAP BIG BEND NECK

Scale, 1 inch = 3000 ft.



THE PASS AT LITTLE BEND NECK, WHERE A 57-FOOT HEAD IS PRACTICABLE

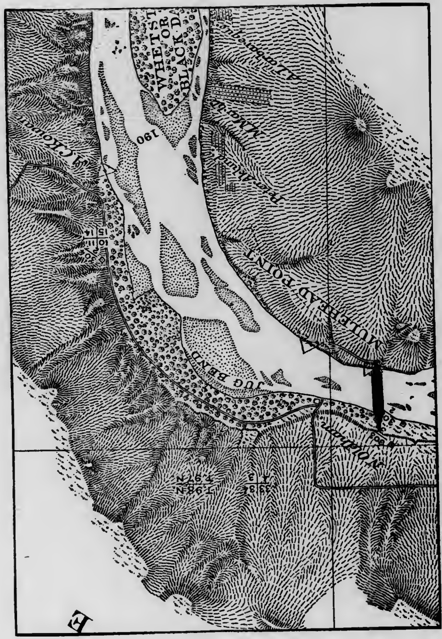


LITTLE BEND

The Little Bend begins at mile 406 and ends at mile 424 being 18 miles around the detour. The neck is of the same width as that at Big Bend, being 1¾ miles. The hill in the gorge is 271 feet above low water. The development here will be by diversion dam and canal, that is the flow of the stream around the bend will be wholly cut off except for extremely high water, and the flow will be diverted through a canal across the neck in which canal, the power house and navigation locks will be erected. The dam in the canal will be a bulkhead over which the water will never pass; floods will fall over the barrier in the old channel and pass around the bend. The dam upon the north side will be 4600 feet long and 41 feet high, above standard low water which added to the natural fall across the neck of 16.5 feet will give a total head of 57.5 feet and will produce at the lowest water known 52,000 effective horsepower constantly. This will be an expensive development but the great power produced will justify the outlay.

Little Bend has been reported upon by Gen. George W. Davis, engineer of the Panama canal, Major Edward Schultz, U. S. Engineer in Charge of the Missouri River, Westinghouse, Church, Kerr & Company and by W. H. Finley, chief engineer of the Chicago and Northwestern Railway, all of whom have declared the physical conditions well adapted to power development, by at least a forty foot dam.

Above Little Bend the slope of the river is less than below that point and the proposed dam will drown the flood plain for 54 miles or up to a point opposite the old town of Scranton, slightly below LeBeau. In so doing a very fine natural power site at Forest City will be drowned.



MULEHEAD POWER SITE

Scale, 1 inch=1 mile.

MULEHEAD

At Mulehead Point, at mile 192.5 above the mouth of the Sioux River, being but a short distance above the Nebraska state line where the stream separates Charles Mix and Gregory counties, the formation is such that a dam 43 feet high will be but 2,250 feet in length. The bedrock at this point is chalkstone. No soundings have been made but at Wheeler, six miles below the Great Northern Railway found bed rock at an average of 47 feet below standard low water and presumably the same condition exists at Mulehead.

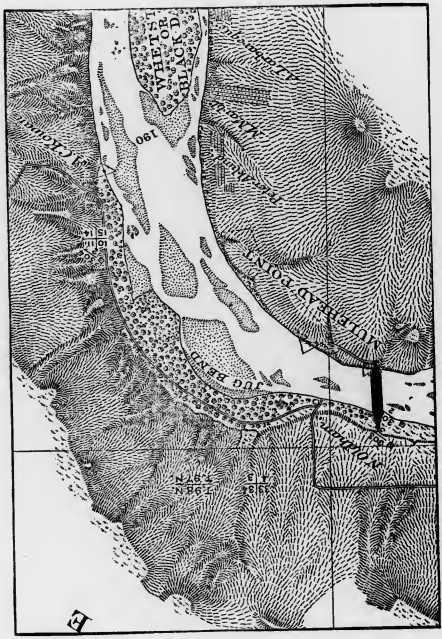
In this section of the Missouri the minimum flow is 11,000 second feet and consequently this proposed dam will produce 43,000 effective horsepower using 80 per cent efficiency of the turbines.

The pool formed by this dam will drown the flood plain for a distance of 45 miles, that is to say it will back the water up to the mouth of Bull Creek, just below White river.

Transmission of 150 miles will carry the current generated at this plant to Sioux City; 115 miles to Sioux Falls, 100 miles to Mitchell; 90 miles to Yankton in addition to the demand of the many intervening points and the thriving cities of the Rosebud.

Because of the very short dam required Mulehead presents one of the most attractive propositions upon the river. At no other point below the Yellowstone is the valley so narrow.

This site is the farthest down stream of any and located as it is in the most thickly settled portion of the state upon the dividing line between the rich southeastern counties and the Rosebud empire and within easy transmission distance of many important municipalities in this and adjoining states it naturally excites the interest of more citizens than any other proposition.



MULEHEAD POWER SITE

Scale, 1 inch = 1 mile.

MULEHEAD

At Mulehead Point, at mile 192.5 above the mouth of the Sioux River, being but a short distance above the Nebraska state line where the stream separates Charles Mix and Gregory counties, the formation is such that a dam 43 feet high will be but 2,250 feet in length. The bedrock at this point is chalkstone. No soundings have been made but at Wheeler, six miles below the Great Northern Railway found bed rock at an average of 47 feet below standard low water and presumably the same condition exists at Mulehead.

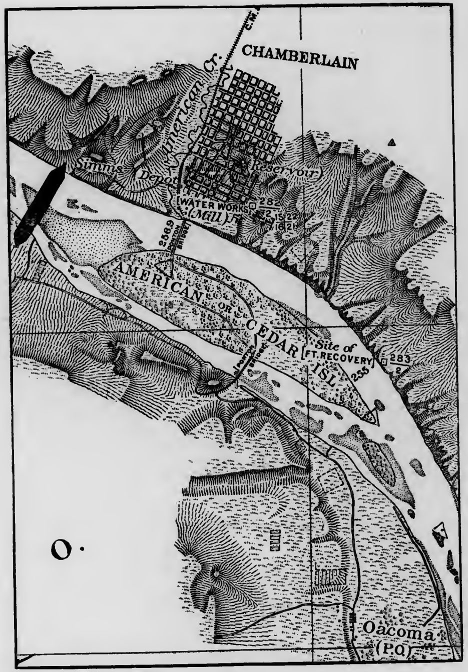
In this section of the Missouri the minimum flow is 11,000 second feet and consequently this proposed dam will produce 43,000 effective horsepower using 80 per cent efficiency of the turbines.

The pool formed by this dam will drown the flood plain for a distance of 45 miles, that is to say it will back the water up to the mouth of Bull Creek, just below White river.

Transmission of 150 miles will carry the current generated at this plant to Sioux City; 115 miles to Sioux Falls, 100 miles to Mitchell; 90 miles to Yankton in addition to the demand of the many intervening points and the thriving cities of the Rosebud.

Because of the very short dam required Mulehead presents one of the most attractive propositions upon the river. At no other point below the Yellowstone is the valley so narrow.

This site is the farthest down stream of any and located as it is in the most thickly settled portion of the state upon the dividing line between the rich southeastern counties and the Rosebud empire and within easy transmission distance of many important municipalities in this and adjoining states it naturally excites the interest of more citizens than any other proposition.



Scale, 1 inch = 1 mile
CHAMBERLAIN POWER SITE

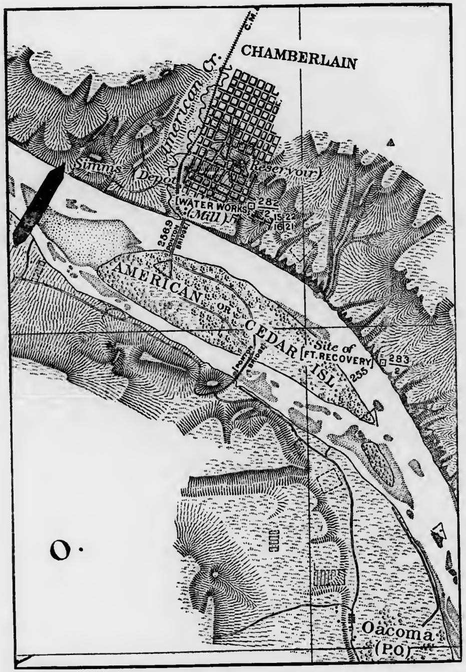
CHAMBERLAIN SITE

Two miles above the city of Chamberlain and 20 miles above the head of Mulehead the banks again converge so that a dam 3950 feet in length will produce a head of 24 feet equaling a minimum of 21,000 effective horsepower. The bedrock here is likewise chalkstone and is about fifty feet below standard low water.

The pool above this dam will run back to the tail race of the proposed development at Big Bend. All the conditions at Chamberlain are favorable to a much higher dam, were it not that to raise the head there would drown Big Bend.

The plant at Chamberlain would be within easy transmission distance of Chamberlain, Mitchell, Huron, Madison, Howard, Woonsocket and other points.

It would likewise be very eligibly located to electrify the Milwaukee Railroad, not only upon its Mitchell-Black Hills line but throughout the state.



Scale, 1 inch=1 mile

CHAMBERLAIN POWER SITE

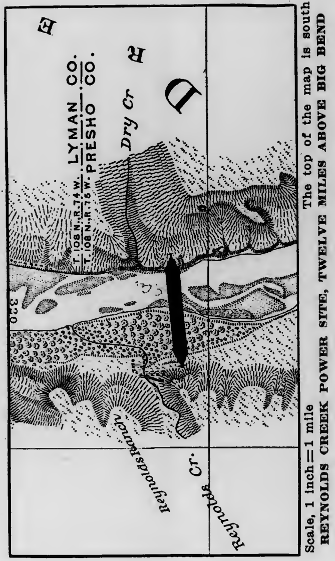
CHAMBERLAIN SITE

Two miles above the city of Chamberlain and 20 miles above the head of Mulehead the banks again converge so that a dam 3950 feet in length will produce a head of 24 feet equaling a minimum of 21,000 effective horsepower. The bedrock here is likewise chalkstone and is about fifty feet below standard low water.

The pool above this dam will run back to the tail race of the proposed development at Big Bend. All the conditions at Chamberlain are favorable to a much higher dam, were it not that to raise the head there would drown Big Bend.

The plant at Chamberlain would be within easy transmission distance of Chamberlain, Mitchell, Huron, Madison, Howard, Woonsocket and other points.

It would likewise be very eligibly located to electrify the Milwaukee Railroad, not only upon its Mitchell-Black Hills line but throughout the state.



Scale, 1 inch = 1 mile

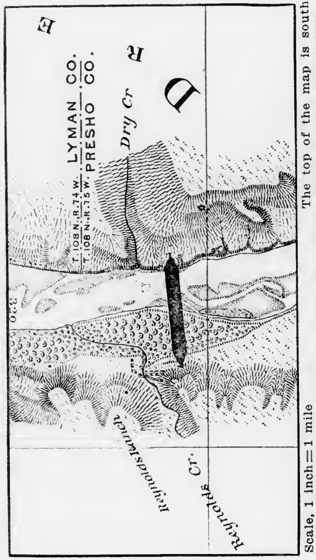
The top of the map is south

REYNOLDS CREEK POWER SITE, TWELVE MILES ABOVE BIG BEND

MISSOURI RIVER AT FT. PIERRE

REYNOLD'S CREEK DAM SITE

This site is twelve miles above Big Bend and 42 miles below Pierre, where the banks converge to within 4500 feet at a point just above the mouth of Reynold's Creek. Here conditions are favorable to building a dam which will afford 40 feet of head and produce 36,000 effective horse power at lowest water. The pool will hold the water back 43 miles or to a point just through the steel bridge at Pierre. The bed rock at Reynold's Creek is Pierre Shale. The point has not been sounded under the stream but the bed rock is presumably at about the same level as at Pierre where it is 46 feet below low water.



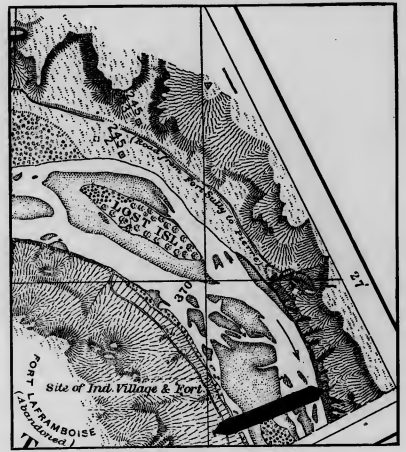
Scale, 1 inch = 1 mile The top of the map is south

REYNOLDS CREEK POWER SITE, TWELVE MILES ABOVE BIG BEND

MISSOURI RIVER AT FT. PIERRE

REYNOLD'S CREEK DAM SITE

This site is twelve miles above Big Bend and 42 miles below Pierre, where the banks converge to within 4500 feet at a point just above the mouth of Reynold's Creek. Here conditions are favorable to building a dam which will afford 40 feet of head and produce 36,000 effective horse power at lowest water. The pool will hold the water back 43 miles or to a point just through the steel bridge at Pierre. The bed rock at Reynold's Creek is Pierre Shale. The point has not been sounded under the stream but the bed rock is presumably at about the same level as at Pierre where it is 46 feet below low water.


245 3
245 2
(Road from Fort Sully to Pierre)
LOST ISL.
370
27
Site of Ind. Village & Fort
FORT LAFRAMBOISE (Abandoned)

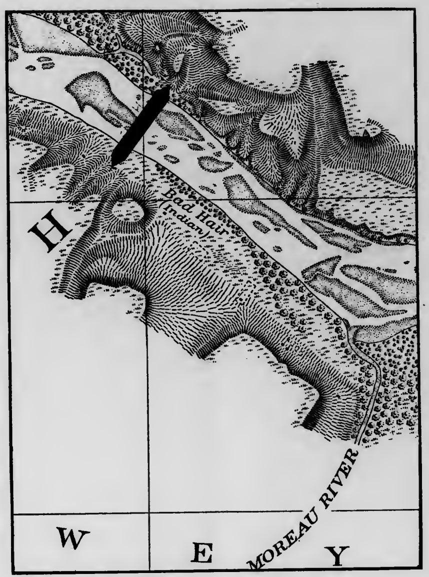
Scale, 1 inch=1 mile

MEDICINE BUTTE POWER SITE

Six Miles Above Pierre

MEDICINE BUTTE

Six miles above Pierre, and five miles above the head of Reynold's Creek slackwater the rim of the Old Ree Fortification at the foot of Medicine Butte, on the west side is 4375 feet from the point of the hill below Robidoux Spring, on the east side and a dam here 34 feet high will back the water to the tail race of the proposed development at Little Bend and will produce 31,000 effective horse power at lowest water. The bed rock is Pierre shale. From this point transmission will be easy into Pierre and throughout central South Dakota.



Scale, 1 inch=1 mile

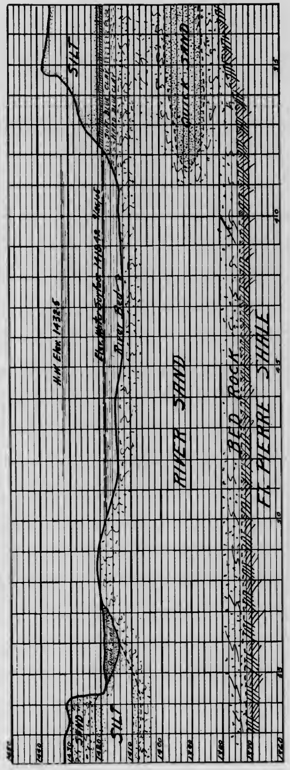
BAD HAIR POWER SITE,
12 Miles Below Mobridge.

BAD HAIR

At Bad Hair's place just above the mouth of the Moreau and only five miles above the head of Little Bend slackwater the banks narrow to only 3500 feet from rim to rim and a head of 45 feet is available producing a minimum of 41,000 horse power; this dam will back the water 64 miles, indicating the growing flatness of the river as we proceed up stream. This section is likewise underlaid by Pierre Shale. One hundred miles of transmission from this plant will put the current into Aberdeen, and the rapidly growing city of Mobridge is but a dozen miles distant from the power site.

EFFECTIVE POWER

In all of the calculations for power production made herein the lowest water ever known has been the basis of the figures and but 80 per cent of the efficiency of the turbines has been calculated. Many manufacturers will guarantee 85 per cent practical efficiency and even a higher rate.



Courtesy Chicago and Northwestern Railway
SECTION ACROSS MISSOURI RIVER UNDER PIERRE BRIDGE

SUMMARY

The combined minimum effective power developable by the proposed plants above suggested is 242,000 horse power. The average flow of the stream will produce at the same heads 552,000 horse power.

THE FLOW OF THE STREAM

The minimum discharge of the Missouri in the northern part of South Dakota is 10,000 second feet. It rarely if ever reaches this minimum. The average discharge is 24,833 second feet, for the entire year and the average for the growing season is 37,500 second feet.

THE SLOPE OF THE MISSOURI

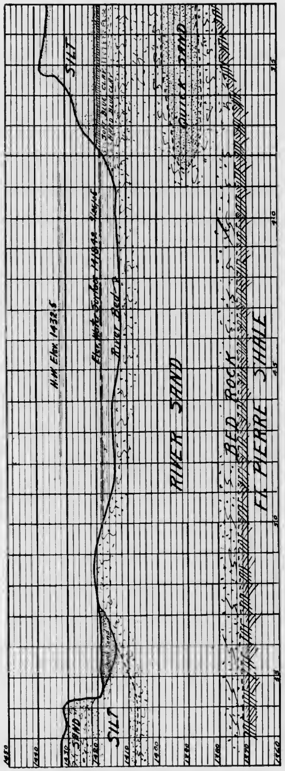
The slope of the Missouri river in South Dakota varies from seven tenths of a foot to the mile in the northern portion to nine tenths of a foot to the mile in the southern portion. That is to say that contrary to the usual opinion the lower section of the river is considerably steeper than the upper section.

THE SILT PROBLEM

Many persons have inquired about the disposition of the silt which the Missouri carries in large quantities. Engineers consulted do not regard this as a very important consideration at the dams. The object of the dams is not to create reservoirs but simply to create head. The pools will doubtless fill with silt but the Missouri may always be depended upon to scour its way through. The course through the turbines will always be the way of least resistance. At the proposed tunnel facilities for frequent flushing must be provided as well as the navigation locks.

NAVIGATION

It will be necessary to build locks for navigation at each dam. At Big Bend there will always be sufficient water passing around the Bend in the navigation season to accommodate the river traffic.



Courtesy Chicago and Northwestern Railway
SECTION ACROSS MISSOURI RIVER UNDER PIERRE BRIDGE

SUMMARY

The combined minimum effective power developable by the proposed plants above suggested is 242,000 horse power. The average flow of the stream will produce at the same heads 552,000 horse power.

THE FLOW OF THE STREAM

The minimum discharge of the Missouri in the northern part of South Dakota is 10,000 second feet. It rarely if ever reaches this minimum. The average discharge is 24,833 second feet, for the entire year and the average for the growing season is 37,500 second feet.

THE SLOPE OF THE MISSOURI

The slope of the Missouri river in South Dakota varies from seven tenths of a foot to the mile in the northern portion to nine tenths of a foot to the mile in the southern portion. That is to say that contrary to the usual opinion the lower section of the river is considerably steeper than the upper section.

THE SILT PROBLEM

Many persons have inquired about the disposition of the silt which the Missouri carries in large quantities. Engineers consulted do not regard this as a very important consideration at the dams. The object of the dams is not to create reservoirs but simply to create head. The pools will doubtless fill with silt but the Missouri may always be depended upon to scour its way through. The course through the turbines will always be the way of least resistance. At the proposed tunnel facilities for frequent flushing must be provided as well as the navigation locks.

NAVIGATION

It will be necessary to build locks for navigation at each dam. At Big Bend there will always be sufficient water passing around the Bend in the navigation season to accommodate the river traffic.

BRIDGES

One of the great conveniences and necessities demanded by the public is the bridging of the Missouri for Railroad and vehicle traffic. With the development of motor vehicles this demand is yearly becoming more and more vehement. Each of the proposed dams will at nominal additional expense provide such bridges and likewise additional revenue.

IRRIGATION

A considerable use for the excess power which may be delivered in the periods of higher wated may be found in pumping water for the irrigation of lands adjacent to the river. This feature may be developed to the fullest limit of the potential power of the higher water since the irrigation season and the flood period are contemporaneous.

MARKET FOR CURRENT

The question most interesting to capital of sufficient potence to undertake a development of power upon the Missouri is that of a market for current so generated. Frankly the market must chiefly be developed. According to the returns of the federal census about 20,000 horsepower are at present being employed in the industries of South Dakota. To increase the demand for electrical current up to the minimum capacity of the Missouri to produce would signify an unparalled industrial development.

There is, however, a considerable market at once available for the product of one or more such plants as are suggested. Transmission to moderate distances will carry the current to cities which are already considerable industrial centers, and they will welcome the opportunity to secure additional power in large quantities. The Milwaukee Railroad has already electrified its mountain divisions and is reported to be anxious to electrify its main line in the Missouri valley. It would undoubtedly at once become a customer for electricity in vast volume, perhaps taking the entire product of one plant. New industries will seek the field for the opportunities offered by such power.

New uses for current will be developed; the agricultural field is sure to be an extensive one. The vast farming regions of South Dakota are becoming rich and the farming people will in the future enjoy facilities and comforts which in the past were reserved for the wealthy in the cities. Electrical equipment will become a necessity for every farm household, for lighting, heating, and for driving domestic machinery, as washing machines, churns, sewing machines and the like. The farms of South Dakota will afford an outlet for a tremendous amount of current as rapidly as it can be transmitted to them.

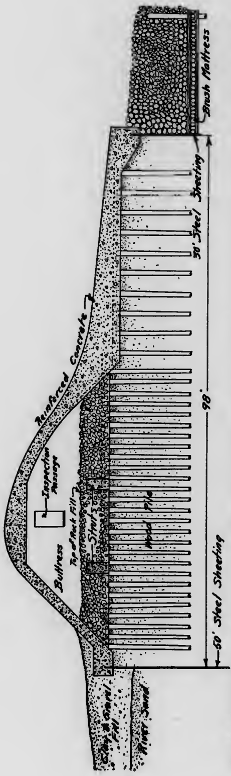
The use of aluminum is growing tremendously and its general use is only limited by the supply. New methods for recovery and refining aluminums are being developed. Until recently only the bauxites have been used, but new patents have been taken out within the past year, which, it is represented, make it entirely practicable to separate the alumina of the common clays. The Pierre shales are rich in alumina, averaging 23 per cent and many places the shales yield as high as 26 per cent alumina and 15 per cent metallic aluminum. This wonderful metal, "as strong as steel, as non corrosiable as silver and as light as wood", is bound to have an increasing place in the world's economy. All of the potential plants on the Missouri above Big Bend are founded in inexhaustible supplies of these aluminum bearing shales, which require cheap electricity in vast volume to successfully separate and refine them. There is a strong reason to believe a great industry will be founded wherever electric power and rich aluminum ores are found in close proximity.

That the market for the current will develop as rapidly as the power plants can be constructed seems certain.

THE COST

The cost of power development upon the Missouri is a subject of first interest, and one of course which is dependent upon the methods employed and local conditions at the site.

The great dam at Keokuk has 32 feet head, a minimum



Cross section of the reinforced concrete hollow dam upon sand foundation in the Wisconsin river at Prairie du Sac. This dam was built in 1914. The floods of three springs have passed over its crest without producing a single settlement crack. While experimental, it appears to be of a character entirely adapted to Missouri river conditions. It cost $514 per linear foot.

of 16000 second feet of flow and develops at lowest water 46,000 efficient horse power. This plant cost $27,000,000.

The engineers of the Federal government estimate the cost of the proposed plant at Muscle Shoals with 97 feet of head and a minimum flow of 7,000 second feet which at lowest water will produce 61,000 horse power to be $16,000,000.

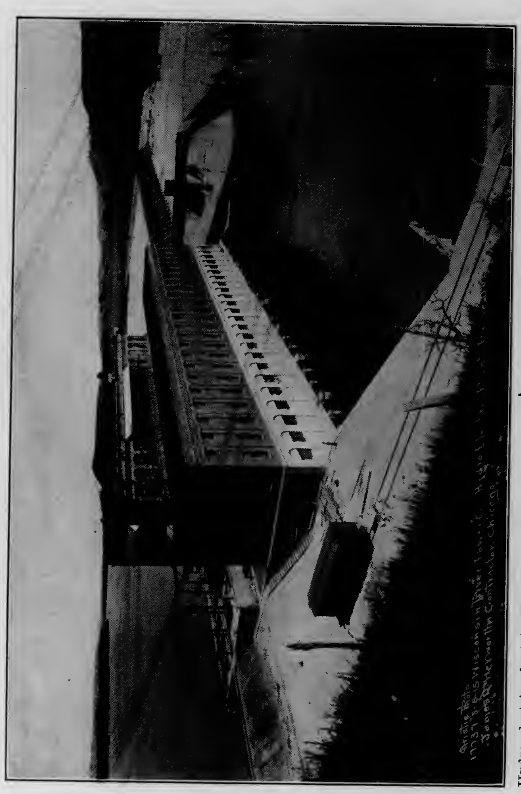
Mr. W. H. Finley, chief engineer of the Northwestern railway estimates the cost of forty foot dam and development at Little Bend, to a fifty seven foot head, with a minimum flow of 10,000 second feet and producing 52,000 horse power at $20,000,000.

It should be stated that Keokuk is the only plant actually constructed.

The Missouri is a sand stream. A dam built in a similar stream at Prairie du Sac, Wisconsin, by the interlocking sheet steel foundation system, and completed in 1914 to a head of 36 feet cost but $514 per linear foot.

DAMS ON SAND FOUNDATIONS

The Missouri River as shown in the cross section is a sand stream. That is there is about forty feet of sand superimposed upon the bed rock under the stream. The safe construction of dams upon such a foundation has long been discussed academically by engineers. At the meeting of the American Society of Civil Engineers. in March 1911, Mr. Arnold C. Koenig, presented an exhaustive paper upon the subject, which was ably and favorably discussed by W. G. Price, Allen Hazen, R. C. Beardsley and other men eminent in the engineering profession. The plan proposed was to confine the sand between curtains of sheet piling and the erection of masonry on this foundation. The plan was successfully tried for small dams at many points, but has been undertaken in a large way so far as can be learned only in the Wisconsin river at Prairie du Sac, where such a dam was built to a 36 foot head and completed in the summer of 1914 and has since withstood the great floods of three springs to the complete satisfaction of its projectors.


Christie Photo
17737 8-6-15 Wisconsin River Power Co. Hydro Ele
James O. Heyworth Contractor, Chicago

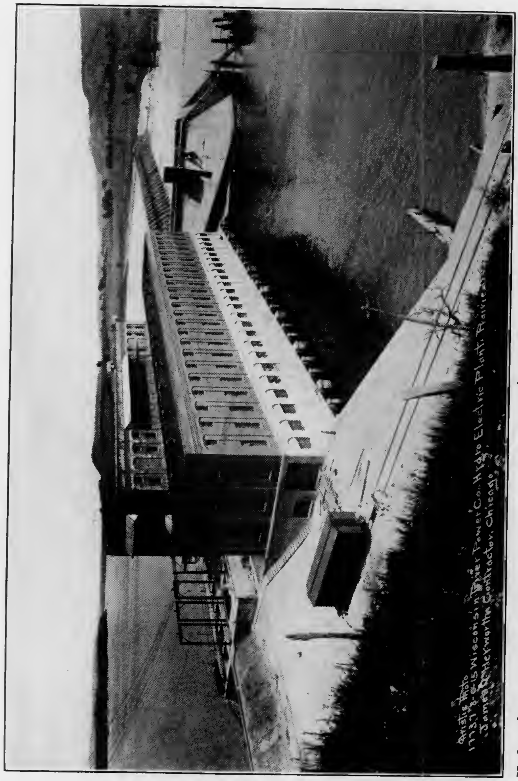
Hydro-electric plant in Wisconsin river at Prairie du sac. All of the structure is upon sand foundation. Observe the heavy navigation locks at the right of the mill.

The plan pursued at Prairie du Sac, where bed rock could not be found at all was briefly as follows:

A curtain of steel sheet piling was driven fifty feet deep, below standard low water entirely across the stream; 98 feet downstream from this curtain another curtain of the same material was driven to a depth of thirty feet. The area between these curtains was driven full of wood piling to a depth of thirty feet; both the steel and wood piling was cut off at low water level. This area between the steel curtains was then filled with sand and gravel to low water level and upon this foundation a hollow concrete, steel reinforced dam was built.

To overcome hydrostatic pressure many weep holes were made in the dam. The foundation for navigation locks and for the great power house were made in the same way. The success of this experiment has attracted much attention from engineers and investors. It will be observed that this dam is hung up on a Wisconsin sand bank and is in no wise anchored to bed rock. A more exacting trial could scarcely be undertaken. The cost of it was but nominal compared with solid concrete construction founded in bed rock.

The success of the experiment in the Wisconsin river gives rise to a great hope for similar success in the Missouri river. Conditions here appear to be vastly more favorable than in the Prairie du Sac enterprise. Here bed rock is every where reached at from forty to fifty feet. The steel sheeting in the Missouri would completely cut off the stream, remove the danger from hydrostatic pressure and safely anchor the dam to bed rock. The continued safety of the Wisconsin river experiment will assure the building of dams in the Missouri at a cost not unduly expensive.


Christie Photo
1737 8-6-15 Wisconsin River Power Co. Hydro Electric Plant, Prair
James O. Heyworth Contractor, Chicago

Hydro-electric plant in Wisconsin river at Prairie du sac. All of the structure is upon sand foundation. Observe the heavy navigation locks at the right of the mill.

The plan pursued at Prairie du Sac, where bed rock could not be found at all was briefly as follows:

A curtain of steel sheet piling was driven fifty feet deep, below standard low water entirely across the stream; 98 feet downstream from this curtain another curtain of the same material was driven to a depth of thirty feet. The area between these curtains was driven full of wood piling to a depth of thirty feet; both the steel and wood piling was cut off at low water level. This area between the steel curtains was then filled with sand and gravel to low water level and upon this foundation a hollow concrete, steel reinforced dam was built.

To overcome hydrostatic pressure many weep holes were made in the dam. The foundation for navigation locks and for the great power house were made in the same way. The success of this experiment has attracted much attention from engineers and investors. It will be observed that this dam is hung up on a Wisconsin sand bank and is in no wise anchored to bed rock. A more exacting trial could scarcely be undertaken. The cost of it was but nominal compared with solid concrete construction founded in bed rock.

The success of the experiment in the Wisconsin river gives rise to a great hope for similar success in the Missouri river. Conditions here appear to be vastly more favorable than in the Prairie du Sac enterprise. Here bed rock is every where reached at from forty to fifty feet. The steel sheeting in the Missouri would completely cut off the stream, remove the danger from hydrostatic pressure and safely anchor the dam to bed rock. The continued safety of the Wisconsin river experiment will assure the building of dams in the Missouri at a cost not unduly expensive.

A DEFINITE STATEMENT

On December 26, 1917, The Fargo Engineering Company, of Jackson, Michigan, who have built more than twenty of the more important dams of the middle west, including the notable soil-founded dam at Welleston, Michigan, which has more than fifty feet head, write:

"Our investigations of sand foundation problems lead us to feel confident that safe dams can be built on sand and we would not hesitate to build a dam, even one hundred feet high on a sand foundation, if proper precautions were taken.

"In your case, (the Missouri river) we do not think it at all necessary to go to bed rock with solid masonry. The length of your dams, from 2500 to 4500 feet will not make the cost prohibitive."

MAJOR GEN. GEORGE W. DAVIS, U. S. A.

"I have amused myself when stationed upon the Missouri with speculations about power development at Little Bend and made careful observations in the vicinity. Unquestionably every condition there is favorable to a great development."

From Report of Westinghouse, Church, Kerr & Company upon the power potentialities at Little Bend of the Missouri:

"It is practicable to develop a water power plant at Little Bend." Nov. 16, 1911.

From Report of Maj. Edward Schulz, Engineer U. S. A. In House Document 91, 61 Cong. First session.

"Water powers may be developed at the Big Bend and the Little Bend of the Missouri, in South Dakota."

CHICAGO AND NORTHWESTERN RAILWAY

Office of the Chief Engineer.

Chicago, August 11, 1917.

Dear Sir:

Answering yours of July thirteenth:

1. The physical features at Little Bend are adapted to the construction of water power, by means of a diversion dam and canal of approximately 40 feet head.

2. The minimum flow of the Missouri at Little Bend is approximately ten thousand second feet.

3. The approximate cost of a complete hydro-electric development at Little Bend upon a safe and permanent basis would be in my judgment at least $20,000,000.

Yours Truly,

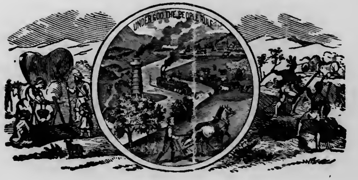
W. H. FINLEY,

Chief Engineer.

THE POWER AMENDMENT

The legislature of 1917 submitted to the voters at the election to be held in November 1918 the following amendment to the Constitution which if approved will become section 10 of Article XIII:

Section 10. The State may purchase, own, develop and operate plants for the development of power, upon the streams of this state and at coal mines upon lands owned by this state and may transmit such power and supply the same to the people of the state. The state may pledge such plants and the accessories thereto to provide funds for such purchase and development any thing in this constitution to the contrary notwithstanding. The legislature by a two thirds vote of the members elect to each house shall provide by law for carrying the provisions of this act into effect.



SOUTH DAKOTA HAS TREMENDOUS UNDEVELOPED RESOURCES

She has the largest gold mine in the world and thousands of undeveloped gold prospects.

She has one of the world's greatest deposits of tin ore practically undeveloped.

She has unlimited stores of cement materials,—clay and lime in the same mine—, in right proportions to make the best Portland Cement.

She has vast quantities of fuller's earth, eligibly located waiting to be marketed.

She has great fields of mica inviting capital to develop them.

She has brilliant oil prospects, to which large capital is already turning.

She has great business opportunities of every description awaiting the captains of industry.

She has 25,000,000 acres of undeveloped farm lands of the greatest fertility.

For full information pertaining to any of these matters address:

CHARLES McCAFFREE,
Commissioner of Immigration,
Pierre, South Dakota.

MSH 23207

END OF
TITLE